CLAIMS

What is claimed is:

1. A method for performing a finite element analysis comprising:

performing a Eularian simulation, wherein a grid having nodes forming elements is superimposed with a material having a surface; and thereafter

projecting the nodes onto the surface of the material; and thereafter

mapping a set of solution variable fields to the material with an Eularian mapping algorithm; and thereafter

performing a Lagrangian simulation.

2. The method of Claim 1, further comprising deleting empty elements and the nodes only connected to empty elements.

3. The method of Claim 1, wherein each element has a fill fraction, and wherein a node within the material surface is projected to the surface if the fill fraction is less than 0.7, and wherein a node without the material surface is projected to the surface if the fill fraction is in the range of about 0.5 to 0.8.

4. The method of Claim 1, wherein the Eularian simulation is explicitly integrated and wherein the Lagrangian simulation is implicitly integrated.

5. The method of Claim 1, further comprising merging selected nodes together after projecting the nodes onto the surface.

6. An automated method of determining the final dimensions of a formed object comprising:

determining the dimensions of the object at first state after a forming operation with an explicit Eularian based finite element simulation; and

determining the dimensions of the object at a final state after the forming operation by running an implicit Lagrangian based finite element simulation using the results of the Eularian based simulation, the results comprising the dimensions at the first state.

7. The method of Claim 6, further comprising converting the results of the Eularian simulation into a Lagrangian mesh before performing the Lagrangian simulation.

8. The method of Claim 7, wherein converting comprises projecting the nodes of the mesh onto a surface of the object.

9. An automated method for performing a finite element simulation comprising:

performing a first phase of the simulation using an Eularian method to determine the dimensions of an object after an initial deformation, wherein an Eularian element grid is formed;

mapping the solution from the Eularian element grid of the first phase onto a Lagrangian element grid; and thereafter

performing a second phase of the simulation using a Lagrangian method to determine the dimensions after shrinkage or springback of the object from the initial deformation.

10. The method of Claim 9, wherein the Eularian element grid is mapped to the Lagrangian element grid using Eularian mapping algorithms.

11. The method of Claim 10, further comprising:

projecting nodes adjacent to the surface of the object to the surface of the object; and

merging certain of the nodes together.

12. A computer readable storage medium storing one or more computer programs for performing a finite element simulation of a material, the computer programs comprising instructions for automatically switching from a Eularian simulation of an initial deformation to a Lagrangian simulation for a subsequent deformation during the finite element simulation.

13. The computer readable storage medium of Claim 12, wherein the subsequent deformation is a springback type deformation resulting from residual energy within the material.

14. The computer readable storage medium of Claim 12, wherein the computer programs further comprise computer instructions for projecting nodes of the Eularian simulation to the surfaces of the material.

15. The computer readable storage medium of Claim 14, wherein the computer programs further comprise computer instructions for automatically mapping the solution variable fields of the Eularian simulation after projection of the nodes.

16. The computer readable storage medium of Claim 12, wherein the computer programs further comprise computer instructions for merging adjacent nodes of the Eularian simulation.

17. The computer readable storage medium of Claim 14, wherein the computer instructions include instructions for projecting nodes of elements within the material to the surface if the element is less than 70 percent full, and for projecting nodes without the material to the surface if the element is 70 percent or more full.

18. A computer system comprising:

one or more computers; and

one or more computer programs running on the computer(s), the computer programs for performing a finite element simulation of a material comprising a first explicit Eularian simulation step and a second implicit Lagrangian simulation step, the computer programs comprising computer instructions for automatically switching from the explicit Eularian simulation step to the implicit Lagrangian simulation step during the finite element simulation.

19. The computer system of Claim 18, wherein the computer programs further comprise computer instructions for converting the grid and the solution variable fields formed during the first Eularian step into a grid and solution variable fields for use in the second Lagrangian step.

20. The computer system of Claim 19, wherein the instructions for converting the grid and solution variable fields include instructions for projecting the nodes of elements of the grid onto a surface of the material.

21. The computer system of Claim 19, wherein the instructions for converting the grid include instructions for merging selected nodes together.

22. A data signal embodied in a carrier wave, the data signal including one or more computer programs for performing a finite element simulation, the computer programs comprising instructions for automatically switching between a Eularian formulation and a Lagrangian formulation during the finite element simulation.

23. The data signal embodied in a carrier wave of Claim 22, wherein the computer programs further comprise computer instructions for beginning the finite element simulation using the Eularian formulation.

24. The data signal embodied in a carrier wave of Claim 22, wherein the computer programs further comprise computer instructions for converting the results and mesh of the Eularian formulation into results and mesh usable for the Lagrangian formulation.

25. A method for performing a finite element analysis, the method comprising automatically switching from an Eulerian formulation to a Lagrangian formulation during the analysis.

26. The method of Claim 25, wherein the Eularian method is explicitly integrated and wherein the Lagrangian method is implicitly integrated.

27. The method of Claim 25, wherein the switching comprises projecting the nodes onto the surface of the material.

28. The method of Claim 27, further comprising mapping a set of solution variable fields to the material with an Eularian mapping algorithm.